

pressure; brisk easterly winds; 15th, continued high pressure and heavy sea swell, and high easterly winds 30 miles; 16th and 17th high pressure; heavy sea swell and high easterly winds, with velocities of 28 and 30 miles.

Colon, Colombia, Charles F. Tallman, Observer:

On the 13th a moderate storm of the norther type prevailed in the afternoon. The weather became threatening at noon, with a sudden increase in the wind, and a few drops of rain fell. The sky cleared partly at 12:15 p. m., but the wind continued to increase, and after 2:30 p. m. varied between north and northwest, with a velocity of 16 to 20 miles an hour. The sea became high during the evening. The wind decreased somewhat during the night of the 13th, and gradually shifted to northeast during the morning of the 14th, backing to north in the evening. The sea continued high, and steamers left their wharves in the early morning and sought anchorage in the mouth of the harbor.

This was the only disturbance of this type during the present norther season.

The character of the storm along the middle Atlantic and New England coasts is shown by the following reports of observers and remarks by newspapers:

New York, S. L. Mosby, Assistant Observer:

Monday, February 13, a blinding snow storm, in conjunction with vast fields of moving ice, closed New York bay and brought ocean traffic to a full stop.

On Saturday morning, February 11, snow was forecast for Saturday night and Sunday. This forecast was published by the afternoon papers, and again by the Sunday morning papers. At 9:10 p. m. (11th), light snow commenced and continued without intermission during Sunday. At 12 o'clock Sunday (12th), warning of heavy snowfall was received, and the warning was repeated in the morning forecast of Monday, February 13. This warning was sent out Sunday afternoon by telegraph and telephone to all lines of railroad whose interests are centered here.

During Sunday night and Monday heavy snow fell without intermission. Up to midnight Sunday (12th), owing to light winds there had been but little confusion on account of snow, notwithstanding the ground was covered to an average depth of 14 inches. About 4 a. m. Monday (13th), a gale came on from the northeast, which continued with increasing force till 4:30 p. m., when it shifted to northwest and continued throughout the night with hurricane velocity. The snow was very dry, and drifted badly; street traffic, which before had not been interrupted, was maintained with great difficulty, and finally abandoned altogether, with the exception of two cable lines. At 8 p. m. (13th), the conditions were worse. The average depth of snow on the ground was 23 inches, and it drifted to a depth of 6 feet in many places. After 8 p. m. the snowfall became lighter, and ceased during the early morning of February 14, with a fall of 15.6 inches during the storm, and a total depth on the ground of 24 inches.

The railroads received most ample warning of the conditions which prevailed on Monday, but they were powerless in the face of such overwhelming odds.

Monday was very generally observed as a holiday, and all business was suspended. When Tuesday morning came, with clearing weather and a resumption of business, the scene in lower Broadway was one of indescribable confusion. All traffic was confined to the narrow space covered by car tracks, while snow was piled on either side to a depth of 8 feet.

The hurricane winds which prevailed Monday night were forecast in ample time, and every effort was made by the station force to distribute the warning.

It is most gratifying to know that the unprecedented weather conditions which prevailed from February 8 to 13, inclusive, were forecast accurately, in ample time to protect all endangered interests. The cold wave was heralded nearly twelve hours in advance; the beginning of snow about the same length of time; more than twelve hours notice of heavy snow; and about eight hours notice of hurricane winds.

Through the afternoon and evening papers these warnings were given to more than a million people engaged in every field of business interested in, and affected by, weather changes. Full credit has been given the Weather Bureau; and the fact that protection was thus afforded the enormous interests concentrated here, will compensate for many minor failures.

The Times Union of Albany, N. Y., of February 13, 1899:

In accordance with the warning sent out yesterday afternoon by the Weather Bureau, this city is to-day experiencing one of the heaviest snowfalls of the year. It is seldom that the Weather Bureau fails in predicting a big storm, and it has been more than successful this year. At the office of the Central Hudson Railroad this morning it is stated that the warning of yesterday saved them thousands of dollars in getting freight that was of a perishable nature under cover.

Boston, Mass., John W. Smith, Local Forecast Official:

A prompt and thorough dissemination of the warning was made by telegraph, telephone, bulletins, and the press. Especial care was taken

to notify all transportation companies and the shipping interests generally. Copies of the message were furnished to officials of the United States Revenue Service, United States Life Saving Service, Light House Service, etc. Great and general interest was manifested. While the wind at this station attained a maximum velocity of only 40 miles from the northeast, it reached hurricane force, and hurricane conditions generally prevailed in the vicinity of this city, especially along the coast. The warnings were timely and fully verified. All shipping remained in port.

Boston Herald, February 15, 1899, editorial:

The Weather Bureau is entitled to distinguished consideration for its services anent the late great storm. It foretold the widespread disturbance with remarkable accuracy, and gave everybody a chance to take a reef.

Portsmouth, N. H. Displayman:

Storm very severe, but shipping was warned in time to prevent sailing. A large number of vessels were notified and remained in harbor, and 13 fishing vessels, manned by crews which aggregated 88, and valued at \$21,300, were detained.

Eastport, Me., D. C. Murphy, Observer:

Hurricane signals on the 13th were posted in all conspicuous places in the city, and the railroad and steamboat lines were notified. Two steamers and two steam ferryboats, valued at about \$150,000, were the only vessels in port, with cargoes valued at about \$25,000, and with crews and passengers numbering about 100 persons. No damage to vessel property is reported. Travel to and from the city was entirely suspended for two days. The snow drifted badly, some drifts being 12 to 15 feet high. The wind reached a velocity of 70 miles from the northeast at 11:30 p. m. on the 13th.

CHICAGO FORECAST DISTRICT.

The severe cold weather which prevailed in the district the last week in January continued during the first half of February, caused by the persistence of high pressure areas of great magnitude in the Western and Northern States and the movement of low areas southward of the district. Temperatures, lower than previously recorded at many stations, occurred on the 8th, 9th, 10th, 11th, and 12th. The continued cold weather was, as a rule, accurately forecasted, and on the afternoon of the 10th a special bulletin was issued as follows:

Noon specials show that the cold wave in the extreme northwest is moving rapidly eastward and southward, thus preventing appreciable moderation in the temperature. Severe cold weather will continue several days.

The warnings must have been of great value to the public. Under date of February 12, Mr. J. C. Piercy, North Platte, Nebr., writes:

The norther and cold-wave warnings of the 10th instant were of inestimable benefit to Mr. Max Beer, a ranchman of this city, who had 200 cows and calves, valued at \$5,000, on cars and on the road. The warnings enabled him to save them, as they could not have stood the storm. It was 35° below zero this morning, the lowest temperature recorded in twenty-six years.

The shipment of perishable goods was almost entirely suspended for three weeks, not even the most improved refrigerator cars affording safety.

On account of the absence of snow the ground in the vicinity of Chicago was frozen in many places to the depth of five and one-half feet, causing great damage by the freezing up of the water and gas mains and service pipes. Plumbers have been unable to meet the demands for their services, and the exigency has brought forward the novel method of thawing out frozen pipes by the use of an electric current. Great suffering was caused by the severe cold among the poorer classes, and many people were frozen to death. Several steamboats which maintain winter service on Lake Michigan were blocked by the thick ice and unable to reach port for three or four days.

Over the greater portion of the district the weather during the second half of the month has been moderate and even mild, but interrupted by the movement of two cold waves,

the first moving across from the 21st to 24th, and the second on the 26th and 27th. Warnings of these two cold waves were issued well in advance of their approach.

Vesselmen on Lake Michigan were kept fully informed as to the expected movement of storms during the month, and no casualty from stress of weather has been reported.—*H. J. Cox, Professor.*

SAN FRANCISCO FORECAST DISTRICT.

From the 2d to the 7th, inclusive, warnings of severe frosts, probably injurious to citrus fruit in exposed places, were issued throughout California. These warnings were fully verified, all Weather Bureau stations reporting heavy or killing frosts on those dates. The usual precautions were taken in the citrus belt to prevent injury, and it is believed that no damage was sustained. There were no important conditions which were not forecast in due time.—*G. H. Willson, Local Forecast Official.*

PORTLAND, OREG., FORECAST DISTRICT.

River forecasts were issued on the 6th, 7th, 8th, 9th, and 10th, and were most favorably commented upon by people along the water front. The feature of the month was the cold period from the 1st to the 8th. Temperatures of zero and slightly below were reported from a few of the more exposed places west of the Cascades, and zero temperatures were general east of them. In portions of Washington, Oregon, and Idaho the lowest temperature on record was observed; this was especially true in the region about Baker City, Oreg. The accuracy of the forecast during this period was made the subject of much favorable comment. During the last half of the month much damage to grain and orchards was reported; the damage was not, however, as great as estimated. The unusual severity of the weather of the month caused a great demand for information upon the local office.—*B. S. Pague, Forecast Official.*

AREAS OF HIGH AND LOW PRESSURE.

During the month there were six highs and nine lows sufficiently well defined to be traced on Charts I and II. In these charts the center of each circle represents the position of the high or low on the date and hour inscribed within. There is also entered in the circle the reading of the barometer near the center. In many cases this reading is quite approximate, especially when the high or low is on the border of the observation region. It should also be noted that sometimes the center has been located by the direction of the winds about it, and not necessarily by the highest or lowest reading of pressure. This is especially the case in the mountain and Plateau regions.

The principal facts regarding the date and place of first and last appearance, the duration, and velocity of these highs and lows are given in the accompanying table, and the following remarks are added:

Highs.—The month has been remarkable in a good many respects. Nearly the highest pressure ever observed in the United States and Canada, 31.42 inches, was reported at Swift Current on the morning of the 11th, and this was a reinforcement of a high area that had been nearly stationary there, or stretching in a ridge of high pressure in a southeast direction to the middle Mississippi Valley since the morning of the 6th. In connection with this ridge of high pressure extremely low temperature was noted in a rather narrow strip from Montana to the middle Atlantic coast. At Washington

a temperature of 15° below zero was experienced at 8 a. m. of the 11th, which was 1° below the lowest ever noted by the Weather Bureau, and this was a radiation cold rather than the cold of a cold wave.

All the highs were first noted to the north of Montana and moved in a southeast direction to the Mississippi Valley, and thence east and northeast to the Atlantic coast. Numbers I and V disappeared off the south Atlantic, II off the middle Atlantic, and the remaining three could be traced to Newfoundland. The severe temperature conditions of the month were mostly in the first half, and were prevalent more in the Southern and Western States than in the Northeast States; at 8 p. m. of the 1st Denver reported a fall in temperature of 48° in twenty-four hours and to -4°, but this cold wave had practically disappeared by the next a. m.; at 8 a. m. of the 7th, in connection with the ridge of high pressure noted above, there was quite a sharp fall in temperature in the middle Gulf States; Mobile had 30° fall in twenty-four hours. This cold spell culminated in Florida at 8 p. m. of the 8th. Jacksonville reported a fall of 40° at 8 a. m. of the 9th. In connection with same ridge the Middle Atlantic States experienced decidedly low temperatures. Atlantic City and New York had a fall of 32°, and Washington a temperature of -6°. The low temperature of this period continued till a. m. of the 11th; at 8 a. m. of 10th Washington reported -8°, and the next morning, -15°.

At 8 p. m. of the 11th, as high III approached the middle Mississippi Valley, Amarillo and Oklahoma reported a fall of 40°, and to -10° and 4°, respectively, and the next a. m. Galveston had a fall of 32° and to 10°. This cold wave moved eastward with the high area, and culminated in Florida on the 13th; at 8 a. m. Jacksonville reported a fall of 38° and to 10°.

As high No. V moved to the middle Mississippi Valley sharp falls in temperature occurred in the Missouri Valley; Moorhead reported a fall of 28°, and to -4° at p. m. of the 26th; at 8 a. m. of the 27th this cold wave reached the lower Lake region, Cleveland reporting a fall of 28° and to 26°.

Movements of centers of areas of high and low pressure.

Number.	First observed.			Last observed.			Path.		Average velocities.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long. W.	Length.	Duration.	Daily.	Hourly.
High areas.										
I.....	*29, a. m.	54	109	2, a. m.	33	78	2,700	4.0	675	28.1
II.....	7, a. m.	52	108	11, p. m.	41	76	1,980	4.5	440	18.8
III.....	9, p. m.	50	116	17, a. m.	47	56	5,370	7.5	716	29.8
IV.....	21, p. m.	52	117	27, a. m.	46	58	3,660	5.5	665	27.7
V.....	24, p. m.	53	118	28, p. m.	32	77	2,730	4.0	682	28.4
VI.....	27, a. m.	53	110	13, a. m.	47	59	2,910	4.0	728	30.3
Total.....							19,350	29.5	3,906	162.6
Mean of 6 paths.....							3,225		651	27.1
Mean of 29.5 days.....									656	27.3
Low areas.										
I.....	1, a. m.	47	126	4, p. m.	45	54	4,470	3.5	1,277	53.2
II.....	3, p. m.	29	101	6, a. m.	36	75	1,740	2.5	696	29.0
III.....	5, p. m.	28	95	9, p. m.	49	54	2,790	4.0	697	29.0
IV.....	8, p. m.	30	107	14, p. m.	48	53	3,690	6.0	615	25.6
V.....	13, a. m.	32	116	17, a. m.	39	70	2,910	4.0	728	30.3
VI.....	14, p. m.	51	117	19, p. m.	46	59	2,790	5.0	558	23.3
VII.....	20, p. m.	37	98	24, a. m.	48	56	2,460	3.5	703	29.3
VIII.....	23, a. m.	32	115	28, a. m.	47	59	3,420	5.0	684	28.5
IX.....	26, p. m.	48	124	11, a. m.	50	62	3,090	2.5	1,236	51.5
Total.....							27,360	36.0	7,194	299.7
Mean of 9 paths.....							3,040		799	33.3
Mean of 36 days.....									760	31.7

*January. †March.

Lows.—Three of the storms were first noted on or near the north Pacific coast, and three more on the south Pacific coast, the remaining three in the west Gulf. The general motion was toward the east and northeast. Seven of the storms dis-